

COMPARISON OF THE VIPER PULSED FUSION ROCKET TO PRIOR FUSION SPACE PROPULSION DESIGNS

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Fusion space propulsion is a proposed space travel concept that can extend the boundaries of human space exploration. The propulsion concept is based on a type of nuclear reaction where light nuclei (reactants) combine to form nuclei (products); in the process some of the initial mass of the reactants get converted into energy. The amount of energy released, like a chemical reaction depends on the types of reactants. There are several potential fuel cycles for nuclear fusion, and each of the reactants has advantages and disadvantages. These reactants include, but are not limited to deuterium-tritium, deuterium-deuterium, and proton-boron11. The energy released in nuclear fusion can be harnessed for power and propulsion. Fusion power systems have the potential to provide unparalleled power budgets to a spacecraft's propulsion system, life support system, and electronics. Fusion power can be used directly to super heat propellant for thrust or, the energetic fusion products can be used as propellant. Some of these systems are operated strictly under steady-state conditions for long-duration continuous power output, while others are designed for short-burst pulsed operation and hence, known as nuclear pulsed propulsion. A series of these fusion bursts can be used to propel the spacecraft, charge power systems, or both. There are also fusion propulsion concepts that utilize a combination of these mechanisms. A preliminary design study of a new nuclear pulsed propulsion concept called the Viper Pulsed Fusion Rocket by Orcutt et. al. [1] in comparison to previously published fusion space propulsion concepts will be presented. The process identifies the requirements of fusion-class systems, and discusses operational parameters such as specific power, specific impulse, and nozzle jet efficiency. An assessment of system characteristics such as mass properties, thrust to weight ratios, power output, and jet power will be presented.

References

[1] John Orcutt , Akshata Krishnamurthy, George H. Miley, Paul Keutelian, Ben Ulmen. Viper PFR: Ultra-high ISP Pulsed Fusion Rocket, DARPA 100-Year Starship Symposium, Sept. 2011.